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OF

The Engineering Society

OF

THE LEHIGH UNIVERSITY.

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JOURNAL

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THE ENGINEERING SOCIETY

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CONSTITUTION AND BY-LAWS OF THE ENGINEERING SOCIETY OF THE LEHIGH UNIVERSITY.

PREAMBLE.

In order to promote a beneficial intercourse among the students in the different schools of Engineering and to increase our knowledge of the science by the establishment of a library, the collection of models, reports on engineering investigations, and any other means which may be of interest to the engineer, we the undersigned unite ourselves into a society to be known as the

ENGINEERING SOCIETY OF THE LEHIGH UNIVERSITY,

under the following Constitution and By-Laws:

CONSTITUTION.

I.—OFFICERS.

The officers of the Society shall be a President, a Vice-President, a Secretary, a Treasurer and a Librarian.

II.—ELECTION OF OFFICERS.

1.—All the offices of this Society shall be filled by active members.

* 2.—The officers shall be chosen by ballot, the majority of the votes cast constituting an election. The election to be held on the first meeting of each academic year.

*See Amendment.

3.—All offices made vacant shall be filled by special election, notice of such election having been given at a previous meeting.

III.—Duties of Officers.

1.—The duties of the President shall be to preside at all meetings, to appoint all committees, and to promote the interests of the Society. He shall call special meetings at the written request of three members.

2.—The Vice-President shall perform the duties of the President in his absence.

3.—The duties of the Secretary shall be to record the transactions of the meetings, and to attend to all correspondence.

4.—The duties of the Treasurer shall be to attend to all financial affairs.

5.—The duties of the Librarian shall be to take charge of the library, models and apparatus, subject to such rules as the Society may establish.

IV.—Members.

1.—There shall be three grades of membership, viz: Active, Associate and Honorary.

2.—The students in the schools of engineering may become active members by complying with the requirements of the Constitution and By-Laws.

3.—All other students and persons of kindred pursuits may become associate members by election (by ballot) on complying with the requirements of the Constitution and By-Laws. They will be entitled to all the privileges of active members, excepting those of voting and holding office.

4.—The officers and alumni of the Lehigh University and other scientific men may become honorary members by a majority *viva voce* vote of the members present at any stated meeting.

V.—Funds.

The funds of the Society shall be appropriated to the liquidation of debts, the purchase of books, and to such other purposes as the Society may direct.

All appropriations shall be made by a vote of the Society.

VI.—Reports of Officers.

The President, Secretary, Treasurer and Librarian, shall present written reports on the condition of their respective offices, at the last meeting but one of the academic year, or when called upon by vote of the Society.

VII.—Amendments.

This Constitution shall not be amended except by a three-fourths (¾) vote of the Society; the amendment to be submitted to the Society in writing, at least two meetings before being acted upon.

Amendments.

April 23d, 1885.

Art. 2.—To read, * * * * The election to be held on the *last* meeting of each academic year.

December 3d, 1885.

Art. 4, Sec. 4.—Alumni who were active members of this Society at the time of their graduation, shall thereafter be considered as honorary members of the Society.

BY-LAWS.

Meetings.

The time of holding all regular meetings of the Society shall be regulated by resolutions of the Society made at any regular meeting of the same, provided there be at least two meetings appointed for every month.

Order of Exercises.

1.—The order of exercises shall be

1. Roll call.
2. Reading minutes of the previous meeting.
3. Secretary's report.
4. Treasurer's report.
5. Librarian's report.
6. Reports of special committees.
7. Miscellaneous business.
8. Nomination and election of members.
9. Election of officers.
10. Unfinished business.
11. New business.
12. Adjournment.

2.—This order of exercises may be suspended for one evening, by a three-fourths (¾) vote of the Society.

Quorum.

A majority of the active members shall constitute a quorum.

Dues.

1.—The initiation fee shall be two dollars ($2.00), which shall be paid within two (2) weeks after election.

Candidates for Membership.

The names of candidates for membership in this Society shall be proposed at least two weeks previous to being acted upon.

Sections.

The Active members of this Society shall, at the beginning of each academic year, be separated into three or more Sections, to be appointed by the President. The duties of each section shall be to report on different matters of interest connected with the special department assigned to it.

Amendments.

These By-Laws shall not be amended except by a two-thirds (⅔) vote of the Society.

The proposed amendment must be submitted to the Society, in writing, at least one meeting before being acted upon.

By-Law Amendments.

Article V.—" Candidates for Membership"—shall read: "The names of candidates for membership in this Society *may be acted upon the at same meeting they are proposed.*"

ABSTRACT OF PROCEEDINGS.

Nov. 19, 1885.—On motion, Mr. E. E. Snyder, '87, and Mr. C. W. Lohse, '87, were elected to membership. The following papers were read before the Society: "The Triangulation of Pennsylvania," by Mr. J. H. Spengler, (read by Mr. Siebert.) "Professional Education in Mexico," by Mr. G. L. de Lara. "A Report of the Hydrographic Survey of a part of the Lehigh River," by Mr. P. D. Millholland. On motion of Mr. Ross, it was decided to inform Messrs. Eisenmann and Blunt, Cleveland, Ohio, that no delegate could be sent to the Civil Engineers' Convention to be held at that place, Dec. 3–5, 1885.

Dec. 3.—The following papers were read before the Society: "On the Preservation of Timber," by Mr. R. C. Gotwald. "The Foundation of the Washington Monument," by Mr. A. Bonnot. "Iron Working in Northampton County, Pa.," by Mr. T. Stevens. The following amendment to Art. iv., Sec. iv. of the Constitution, was adopted: Alumni who were active members of this Society at the time of their graduation, shall be considered as Honorary members.

Feb. 4, 1886.—On motion, Mr. O. O. Terrill, '87, was elected to membership. Prof. E. H. Williams, Jr., addressed the Society on "Requisites for a Successful Engineer."

FEB. 18.—The Librarian reported the receipt of pamphlets and printed proceedings of the Convention of Civil Engineers. at Cleveland, Ohio, Dec. 3–5, 1885. The following papers were read before the Society: "Early surveying Instruments," by Mr. J. S. Seibert. "The Holyoke (Mass.) Dam and Water Power," by Mr. H. G. Reist. "Mine Water Formations," by Mr. G. S. Patterson, E.M , '83, (read by Mr. Bonnot.)

MARCH 4.—The following papers were read: "On the Future Water Supply of Philadelphia," by Mr. L. J. H. Grossart. "Notes on Long Column Formulæ," by Mr. J. H. Spengler. "Two Recent Mine Accidents, (Mocanoqua and Nanticoke)," by Mr. E. S. Stackhouse: discussion. Papers for publication were received from Prof. Merriman, on "The Internal Work and the Deflection of Beams," and from A. P. Smith, M.E., '84, on "Boring the Big Aqueduct."

THE INTERNAL WORK AND THE DEFLECTION OF BEAMS.

When a beam deflects under the action of a load P, the force of gravity performs an external work, which is measured by the product of the load P and the deflection Δ of its point of application. This work is done in elongating and compressing the fibers of the beam against the elastic resistance of the material. Let W denote this internal work in the entire beam. Then

$$P\Delta = W, \qquad (1)$$

because the work of the applied force must be equal to the work of the resisting forces.

If the internal work W can be expressed in the terms of the dimensions of the beam and the co-efficient of elasticity of the material, we shall be able to find the deflection Δ from (1), without knowing the nature of the elastic curve.

To establish a general expression for the internal work W, let M be the bending moment of the external forces on one side of a cross-section, whose distance from an assumed origin is x. Let c be the distance from the neutral axis of the cross-section to the most remote horizontal fiber, and let s be the unit-stress in that fiber. Let a be the area of any elementary fiber whose distance from the neutral axis is z. Then, because the unit-stresses are proportional

to the distances of the respective fibers from the neutral axis, we have,

$$\frac{S}{c} = \text{unit-stress at the distance unity,}$$

$$\frac{S}{c}z = \text{unit-stress at the distance } z,$$

$$\frac{S}{c}az = \text{total stress on any fiber of area } a,$$

$$\frac{S}{c}az^2 = \text{moment of stress in fiber } a,$$

$$\frac{S}{c}\Sigma az^2 = \text{total internal resisting moment} = M.$$

But Σaz^2 is the moment of inertia of the cross-section with reference to the neutral axis and may be denoted by I. Therefore,

$$\frac{SI}{c} = M \qquad (2)$$

which is well known as the most important formula in the theor of flexure. Now the elementary stress $\frac{Saz}{c}$ causes an elongation or compression λ, which may be found from the definition of the co-efficient of elasticity E, and the product $\lambda \frac{Saz}{c}$ will be the elementary work of the fiber a. Thus, in the distance dx,

$$\frac{Sz\,dx}{c\,E} = \text{elongation or compression of the fiber } a,$$

$$\frac{S^2\,az^2}{c^2\,E}dx = \text{work of the fiber } a \text{ in the distance } dx,$$

$$\frac{S^2\,\Sigma az^2}{c^2\,E}dx = \text{work of the cross-section in the distance } dx,$$

Here Σaz^2 is to be replaced by I, and for $\frac{S}{c}$ is to be put its value from (2) Then we have the simpler expression,

$$\frac{M^2}{EI}dx = \text{internal work of cross-section in the distance } dx.$$

The total internal work in the beam now is,

$$W = \int \frac{M^2}{EI}dx \qquad (3)$$

in which the integration is to be extended to cover the entire beam.

From (1) and (3) the deflection of the point of application of the single load P hence is

$$\Delta = \int \frac{M^2}{PEI}dx \qquad (4)$$

from which Δ can be found for particular cases.

For instance, consider a contilever of the length l, carrying the load P at the free end. Then $M = Px$ and (4) becomes

$$\Delta = \int_0^l \frac{Px^2\,dx}{EI} = \frac{Pl^3}{3EI}$$

which is the same as found by the use of the elastic curve.

Again for a simple beam loaded at the middle we have $M = \frac{1}{2}Px$, and the work done in the whole beam will be twice the work done in one-half of it. Then

$$\Delta = 2\int_0^{\frac{1}{2}l} \frac{Px^2\,dx}{4EI} = \frac{Pl^3}{48EI}$$

which is the same as found by the usual method.

If a load P be placed upon a simple beam at a distance kl from the left hand support, the reaction of the left support is $P(1-k)$ and the reaction of the right support is Pk. The moment on the left of the load is $M = P(1-k)x$, and that on the right of the load is $M = Pk(l-x)$, counting the x in both cases from the left support. Then in order to extend the integration in (4) over the entire beam the integral including the first moment must be taken between the limits 0 and kl, and the integral including the second moment between the limits kl and l. Thus,

$$\Delta = \int_0^{kl} \frac{P(1-k)^2x^2dx}{EI} + \int_{kl}^{l} \frac{Pk^2(l-x)^2}{EI}$$

Performing the indicated operations we find

$$\Delta = \frac{Pl^3k^3(1-2k+k^2)}{3EI}$$

If $k = 0$ or $k = 1$, the load is at the support, and $\Delta = 0$. If $k = \frac{1}{2}$ we find $\Delta = \dfrac{Pl^3}{48EI}$ as before deduced for a load at the middle. If $k = \frac{1}{4}$ or $k = \frac{3}{4}$, the value of Δ is $\dfrac{3Pl^3}{1024EI}$ or less than one-seventh of that when $k = \frac{1}{2}$.

This method is not applicable to the determination of the maximum deflexion in a case like that just discussed, since the point of maximum deflection is not under the load. Nor is it applicable to the deflection caused by uniformly distributed loads. Formula (3) however will furnish a comparison between the internal work caused by concentrated and uniform loads. For instance, for a simple beam loaded with P in the middle (3) gives

$$W = \frac{P^2l^3}{48EI}$$

while for the same load uniformly distributed (3) gives

$$W = \frac{P^2 l^3}{120 EI}$$

so that the internal work due to the concentrated load is 2½ times that due to an equivalent uniform load.

MANSFIELD MERRIMAN.

BORING THE BIG AQUEDUCT.

FROM THE NEW YORK TRIBUNE.

New York people rarely think of the new aqueduct except when a tremendous explosion of loose dynamite or a horrible accident somewhere along its line shocks their senses or their sensibilities. Sometimes tax-payers think of it and groan in bitterness of spirit when they see a little matter of ten or fifteen million dollars tacked on to the city's debt and vaguely wonder if the money and lives and dynamite that are being put into those holes in the ground will ever result in a real aqueduct. But in spite of all this indifference and ignorance and misapprehension of the nature and state of the work, the enormous expenditure of money and energy goes regularly on; hundreds of powerful drills are hammering away at the unyielding rock; the rumble of the blast and the puffing of the hoisting engine testify to the uselessness of nature's resistance to invasion, and the engineers' figures indicate that at the present rate of progress all will be finished by September 30, 1887, as called for in the contracts. It is characteristic of New York that this work, in many ways the greatest of its kind ever undertaken, should go on almost unnoticed except by engineers who recognize its magnitude and novelty. The present discussion about the proper means and methods for gathering a supply of water to fill the big tunnel has, however, reawakened interest in the aqueduct among people who know little about engineering precedent and much about taxpaying.

The total amount of tunnelling to be done is thirty-three and one-fifth miles from Croton Lake to the Central Park reservoir. Work on the twenty-eight and a quarter miles north of the Harlem River has been in progress for nearly a year. The following statement shows the work to be done and the work already done on the thirty-one shafts and the parts of the tunnel connected with

them: No. 0 is the shaft nearest the lake. Its depth is 210 feet; distance to be tunnelled, 2,480 feet to the south; length of tunnel driven up to January 30, 1886, 1,670.5 feet. Shaft No. 1—depth, 333 feet; distance to be tunnelled, 2,067 feet north, 3,201 south; distance driven up to January 30, 2.920 north, 2,700 south. No. 2—depth, 382 feet; distance to be tunnelled, 3,201 feet north, 3,-100 south; distance already driven up to January 30, north 21.7 feet, south 17.2 feet. No.3—depth, 377 feet; distance to be tun-nelled, 3,100 feet north, 3,219 south; distance already driven, north 138.8 feet, south 124.9 feet. No. 4—depth of shaft, 250 feet; distance to be tunnelled, north 3,381 feet, south 3,079 feet; distance already driven, north 816.5 feet, south 764 feet. No. 5—depth, 116 feet; distance to be tunnelled, north 3,518 feet, south 3,318 feet; distance already driven, north 1,120 feet, south 991 feet. No. 6—depth, 178 feet; distance to be tunneled, north 3,180 feet, south 3,049 feet; distance already driven, north 513 feet, south 485 feet. No. 7—depth, 188 feet; distance to be tunnelled, north 3,050, south 737; distance already driven, north 850 feet, south 802.

Where Shaft No. 8 should be the aqueduct comes up to the surface, or rather the surface comes down to the aqueduct. Then it passes through a little hill and comes to the surface again where Shaft No. 9 should be. Here work is begun by digging a trench and boring into the side of the hill. These points of attack are called portals. The total amount of this open trench work is approximately 3,000 feet in the entire aqueduct. At Portal No. 8 north, the distance to be dug or tunnelled is 769 feet north and 875 feet south. At Portal No, 8 south, the distance to be dug or tunnelled is 875 feet north, 822 feet south. No work has been done here up to January 30. From Shaft No. 9 there are 2,135 feet to be dug and tunnelled to the north, of which 1,113 feet have already been done; distance to be tunnelled to the south, 3,-222 feet; distance already driven, 1,799 feet. Shaft No. 10—depth, 132 feet; distance to be tunnelled, north 3,222 feet, south 3.713 feet; distance already driven, north 1,228, south 1,144 feet. No. 11 A—depth, 55 feet; distance to be tunneled, north 3,867 feet, south 584 feet; distance already driven, north 2,042 feet, south 25 feet. No. 11 B—depth 48 feet; distance to be tunnelled, north 585 feet, south 3,800 feet; distanee already driven, north 43.6 feet, south 1,830 feet This work has all been done under contract by Brown, Howard & Co.

Shaft No. 12 A has a depth of 53 feet; distance to be tunnelled, north 3,768 feet, south 546 feet; distance already driven, north, 1,070 feet, south 204 feet. No. 12 B—depth, 53; distance to be tunneled, north 546 feet, south 1,975 feet; distance already driven, north 0 feet, south 942 feet. No. 13—depth, 155 feet; distance to be tunnelled, north 1,817 feet, south 2,491 feet; distance already driven, north 736.6 feet, south 447.4 feet. No. 14—depth, 28 feet; distance to be tunnelled, north 2,707 feet, south 263 feet; distance already driven, north 1,162.9 feet, south 35.8 feet. The distance to be tunnelled north from No. 14 A is 252 feet, south 2,993 feet; distance actually driven, north 0 feet, south 1,062 feet. Depth of shaft No. 15, 127 feet; distance to be tunnelled, north 2,993 feet, south 3,845 feet; distance already driven, north 612.2 feet, south 626.8 feet. No. 16—depth, 72 feet; distance to be tunnelled, north 4,006 feet, south 3,550 feet; distance already driven, north 1,051.1 feet, south 1,203.9 feet. No. 17—depth, 68 feet; distance to be tunnelled, north 3,550 feet, south 3,690; distance already driven, north 1,303 feet, south 1,089 feet. Between shafts Nos. 17 and 18 there is another portal from which they will work 3,542 feet north and 1,608 feet south. From Shaft No. 18, where the aqueduct again pierces the earth, there is a distance of 1,608 feet to be worked to the north and 3,583 feet to the south; the distance already covered is, north 1,313 feet, south 455 feet. Shaft No. 19 has a depth of 72 feet; distance to be tunnelled, north 3,733 feet, south 3,184 feet; distance already driven, north 725 feet, south 880 feet. From No. 12 A to No. 19 inclusive the work is being done by O'Brien & Clark, contractors.

Shaft No. 20 has a depth of 128 feet; distance to be tunnelled, north 3,486 feet, south 2,712 feet; distance already driven, north 1,192 feet, south 974 feet. No. 21—depth, 100 feet; distance to be tunnelled, north 2,713 feet, south 3,463, distance already driven, north 1,042 feet, south 955 feet. No. 22—depth, 85 feet; distance to be tunnelled, north 3,464 feet, south 1,970 feet; distance already driven, north 1,210 feet, south 1,118 feet. No. 23—depth, 71 feet; distance to be tunnelled, north 1,970 feet, south 2,140 feet; distance already driven, north 1,127 feet, south 1,121 feet. No. 24—depth, 183 feet; distance to be tunnelled, north 2,140 feet, south 75 feet; distance already driven, north 415 feet, south 75 feet. These last are all under contract to Colonel Heman Clark. The remaining portions have been let as follows: Section No. 12, including the inverted siphon under the Harlem

River, to O'Brien & Clark for $430,345 ; Section No. 13 to John Brunton & Co., for $418,565, and Section No. 14 to the same for $619,115. This brings the total contract price of the entire aqueduct, including the gate-house at the Croton Dam, up to the neat little sum of $13,800,367.

Work on all the shafts except Nos. 1 and 14 was begun in January, 1885. The two exceptions were opened in February and March respectively. The shafts were sunk at an average monthly rate varying from 70 feet in No. 1 to 8.7 feet in No. 11 B. This rate of progress depended, of course, on the nature of the material encountered. Each shaft was sunk to the level of the tunnel and then a few feet further to form a sump in which the water collects and from which it is lifted to the surface by the pumps. The shafts reached the requisite depths at various times, from March to December, and work on the tunnels in either or both directions was begun immediately from the foot of each. The average date for beginning was about the first of June. In the eight months following that date eight and a half miles of tunnel have been driven. This is at the rate of a mile a month or a quarter of a mile a week. As the work must be finished by September 30, 1887, the contractors have nineteen months more in which to complete it. As there are twenty more miles of tunnel to be driven north of the Harlem River this would make a pretty close calculation at the past rate of progress of a mile a month. They are now increasing the pace, however, and have attained a speed of a third of a mile a week. This will carry them through in time and leave more or less of a margin for the bricking up, etc., which must be done before the contract is fulfilled. The shafts will also have to be bricked up and furnished with strong iron gates to resist the upward thrust of the water.

The aqueduct for the larger portion of its length will have a diameter of 13½ feet. This with the average fall of seven-tenths of a foot to the mile and the head of water from the lake, gives a flow of 320,000,000 gallons per day. At a point a mile or two above the place where it goes under the Harlem River a distributing reservoir for the annexed district is to be placed. Below that the diameter is reduced to 13¼ feet, and the flow will be 250,000,000 gallons a day. Above the point mentioned the cross section is an arch with a convex base ; below it is a circle. The borings of the engineers showed that the material through which the tunnels were to be driven was 90 per cent. rock. The rock was

generally shown to be a compact gneiss, occasionally mixed with dolomite, felspar, mica, hornblende and kaolin. Experience has shown that even a higher percentage was rock than the engineers had supposed.

Another case in which the borings proved partly false was at Gould's Swamp, near Shaft No. 11, which is not far from Tarrytown. The borings showed thirty-five feet of quicksand and then solid rock. The contractors have found over fifty feet of quicksand. It would have been a difficult job to tunnel through this soft material, and even if successful the place would always have been a weak point in the aqueduct. So they went down at a steep incline on either side of the swamp until a sufficient depth was reached to insure solid rock and then the tunnel was run through that. The greatest trouble which the contractors have encountered has been the breaking down of the rock from the roof. The "dip," as the geologists call the inclination of the strata in the rock, is so nearly vertical that, in order to insure a clear passage of the requisite cross section, about 25 per cent. more rock has to be taken out than was first calculated on. This will bring the total quantity of material taken out of tunnel and shafts up to 50,000,000 cubic feet at a rough approximation. These figures bring the work well up to the front among the great tunnelling undertakings of the world, while for simple length it is the greatest among its kind. Besides the dip under Gould's Swamp, there is a drop of 100 feet near Shaft No. 20, and a dip of 200 feet to get under the bed of the Harlem River. This will bring the bottom of the inverted siphon about 400 feet below the level of Croton Lake, and subject its sides to a hydrostatic pressure of 200 pounds to the square inch,—something never before encountered in the building of aqueducts.

The number of shafts and portals in that part of the aqueduct above the Harlem River is thirty-one. At each shaft an average of 125 men are employed. Thus the total number at work is between 4,000 and 5,000. The men are divided into two shifts of twelve hours each. Their duties are as follows: At the mouth of the shaft in each shift there is one foreman who oversees matters above ground and in the shaft; there is a blacksmith and his helper, who are engaged in dressing the drills and tinkering at broken-down machinery; there are two engineers to run the hoisting engines, air compressors, etc., and two laborers to handle the cars of rock and earth that are hoisted up from the foot of the

shaft. There are also three topmen who divide the twenty-four hours between them and look out for the hoist and see that no one tumbles down the shaft. This makes seventeen men working above ground in every twenty-four hours. Below ground there are two headings, as the two parts of the tunnel running in opposite directions are called. In each heading there are twenty-seven men working at the same time, or 108 men who work under ground in every twenty-four hours.

At the head of the force in each heading is a foreman. Next to him in importance are the six machine runners, each of whom has charge of a power drill driven by compressed air. The machine runners guide the drill and see that everything is going right. Each one has a helper whose general duty it is to do whatever he is told, while his particular occupation is to twist the screw by which the drill is fed up to its work. For this last he is sometimes called a "tailer." Behind and about the six machine runners and their six helpers work twelve "muckers." The subterranean "mucker" is not like his brother of the upper world whose song is "Hey, git on to de dude!" and who neither toils nor spins. The under-ground "mucker" is the hardest-worked man on the shift. With pick and shovel he breaks up the rock that the blast has broken down and loads it on the car, and then he or an equally hard-worked mule drags the car to the foot of the shaft and on the platform of the hoist. The rest of the shift consist of a "nipper" and a water carrier. There is also a billman for each heading. He measures up the progress made each day, keeps accounts of the explosives used, etc. The duties of the "nipper" are much more pacific than would be supposed from the name. He merely takes up the dulled and broken drills, which are thrown behind them by the machine runners, takes them out to the blacksmith to be fixed, and brings back the re-sharpened ones. It was a "nipper" whose life was nipped short a few weeks ago by a singular accident. While going up the hoist with a long drill in his hand he carelessly let it lean over to one side so that the end struck a projecting rock or timber. Quicker than thought the other end gouged into his abdomenn and pinned him against the opposite side of the shaft.

There are between 300 or 400 Ingersoll and Rand drills used on the aqueduct. They drive a hole three and a half inches in diameter. The first thing in cutting a tunnel is to drive a heading which is the entire width of the tunnel and about five feet in

height, measuring from the roof down. This leaves the rest of the material which is to be removed in the shape of a "bench," from which it can be easily worked out. In the aqueduct the dimensions of the bench are about fifteen feet, or the entire breadth of the tunnel, by ten feet in height. The bench is kept close up to the heading, only enough of it being left to afford foot-hold to the drills. Of these latter there are six; four working at the heading and two at the bench. The former are mounted upon columns which are wedged in between the roof and the bench. Each column supports two drills. They are all driven by compressed air under a pressure of eighty pounds to the square inch, brought down from the surface in pipes. The drills drive holes in at the outer edges of the heading, some straight into the rock and some slanting toward the centre, so that the explosion will tend to drive the face of the rock outward. There are twenty-one holes in each heading. They are charged with two or three pounds of dynamite each and exploded by electricity. The rock thus broken down is removed by the industrious "mucker." The two drills on the bench are mounted on tripods. They drive holes downward and backward to the desired depths, and the explosion of their charges easily upsets the bench.

The rate of advance has been estimated at about ten feet per shift, or twenty feet a day in each heading. The advance for each blast in the heading is from four feet to five feet nine inches, according to the hardness of the rock. In the bench it is six feet per blast. Experiments with different explosives have shown the amount used per blast to be from sixty-five pounds of pure gelatine to 125 pounds where forcite and other weaker ingredients were mixed with the gelatine. The average cost of explosives for each foot of tunnel driven is $12, while the variation is between the two extremes of $8 and $19. The amount of explosives used for every foot of tunnel driven varies with the condition, but generally falls between twenty-five and thirty pounds. Using the lower limit this makes the amount going down each shaft from which two headings are driven, to be 1,000 pounds every twenty-four hours, while the total amount used on the aqueduct, reckoning from a weekly progress of a third of a mile, would be 44,000 pounds a week, or over 7,000 pounds a day. This seeming discrepancy is due to the fact that at some of the shafts no work is being done, while from many of the others only one heading is at present being driven. The rate of ten feet per shift is also proba-

bly much above the average. These figures give to the total length of 174,000 feet of the completed aqueduct, a consumption of between four and five million pounds of explosives. If the explosion of a beggarly 125 pounds nearly blew the annexed district out of the State the other day, what an enormous force is here being chained down to the work of supplying cold water to the future blue ribbon brigades of New York. A. P. SMITH.

TECHNICAL EDUCATION IN MEXICO.

In Mexico as in the United States, the Government takes great care of the education of the people. There are public schools where a fair education may be obtained, such as is necessary for the ordinary affairs of life. The institutions for professional education in Engineering, Medicine and Law are also under Government patronage. The two principal institutions of this class are in the City of Mexico and in Guadalajara, in the State of Jalisco. The school of Engineering in Mexico City is more especially for Mining and Civil Engineering. There is a department of Mechanical Engineering, but owing to the lack of shops for practice, very few follow this branch there, preferring the American or German schools.

The Mining School has a very fair rank, most of the professors having been educated in France, and some being of French or German nationality. Besides, we have so many silver and gold mines that there is an extensive field for practice. The course in Civil Engineering is, with a few exceptions, similar to that at Lehigh. They include, for instance, a thorough course in architecture, but do not require Crystallography, Mineralogy and Mechanics of Machinery.

In Guadalajara, my native place, we are proud to say that we have the best schools of Medicine and Law in the country, but the School of Engineering is not so extensive as that in the City of Mexico, teaching, as they do, only Civil Engineering. In this school I took the civil course, and I shall give you a short description of it.

In an institution called Lices de Varones every student is prepared for the school which he wishes to enter. Those desiring to enter the engineering schools are required to take arith-

metic, algebra, geometry, trigonometry, physics, elementary astronomy, drawing, history, Spanish literature, philosophy, physiology, and Spanish, French and English languages. There is just sufficient to keep one busy for two years. Students intending to follow Medicine or the Law take the classics. A certificate of a secondary, or what you might call a high school, is necessary for admittance to this school.

After passing all the examinations here, the student passes to the School of Engineering, where he receives instruction in analytical and descriptive geometry, differential and integral calculus, mechanics, surveying, general and special construction of buildings, highways, stone bridges and canals, stone-cutting, hydraulics, practical astronomy, geodesy, political economy and a great deal of topographical and architectural drawing. Good practice in surveying is also given, and after this four months practice is required in the State works. Of course, no pay is received, but the tuition is free. When I took the course, the Government had in view the water supply of the city, and in my last year I was charged to survey and take the levels of a part of the mountain where the springs are situated. The studies above mentioned require three years, after which the student prepares his thesis, and also prepares himself for a hard examination, the satisfactory passing of which entitles him to his diploma. The last examination, which we call the professional one, is principally in the studies of practical application, to know whether a man understands what he is going to do.

The examinations and marks do not differ much from what we have here. The marks range from one to ten, and a mark of four is required to pass. The examinations are oral, and last two hours, and the professional one three hours.

I shall now tell you something about the student's life, which, while not instructive, may perhaps be interesting. It is as jolly and mischievous as anywhere else. Students in the city have a very bad reputation, it being said that the students and the devil are the same thing. They are great "mashers" too, although this tendency leads to bad results, sometimes in fights for some fair one's sake, and then come the duels and the rest of the chivalry.

There is a ladies' college not far from the city, where the students go to have a good time. The girls are kept very strict. The lady who has charge of them is a tall old woman, with gray hair and a majestic countenance. Probably on account of old age

she has lost her front teeth, so that it is difficult to distinguish her smiles from her frowns. She supposes herself to be the most intelligent woman in the whole country, and really one can appreciate it in the way she swears at the students when she becomes angry at them. The girls call her Madame Mercedes.

In those moonlight evenings, so brilliant in the tropics, the students often go in a body to the seminary, and many of them being good musicians, take their instruments with them. After a serenade and the explosion of fire-crackers, etc., the scene ends with the appearance of Madame Mercedes at a window, from which she berates the students in choice language, or perhaps a policeman disperses the crowd.

Some of the students indeed work hard, but, as is the case everywhere, others do nothing. I am glad to say that our institutions of learning are growing every day, and I hope that in time they will compare favorably with those of any other country. Mining engineering particularly is making rapid advances year by year, and all the graduates find good positions in our silver mines. Civil engineering is also growing very fast, owing to the great opening for railroads and the survey of property. I expect to take special interest in professional education when I return to Mexico, and I shall endeavor to establish the system of teaching employed in the Lehigh University.

G. L. de Lara.

REQUISITES FOR A SUCCESSFUL ENGINEER.

A man should cultivate strict integrity regarding himself and the world. A great majority of the failures in the world are due to a want of this quality. It is as bad to cheat one's self as his neighbor, and the first thing needful in an engineer is the ability to judge fairly of his tastes and powers and deduce from them a line of work. If we find ourselves mistaken at any period of our lives, if we find that we have chosen a wrong profession, we must be fair enough with ourselves to acknowledge the fact and abandon our profession for one more congenial to our tastes, no matter what the world may say. There are plenty of good mechanics struggling through the world in other trades, and it should be our endeavor to prevent a repetition of the process in our own lives.

We should also be known to the world as persons of unques-

tionable integrity. That quality must be above suspicion, and we must remember that our prosperity, our lasting prosperity, will depend upon whether our employers can trust us.

In no profession is integrity more desirable than in engineering, because that profession is a land comparatively unknown to the world at large, and the chances for deception are so abundant and so little liable to detection.

Therefore, in making your reports be guided strictly by the truth, even though it may bring you to a result unpalatable to yourself and the party for whom you work. It will impress that party, however, that you are trustworthy.

Again, an engineer should cultivate his perceptive faculties, for the measure of success depends in great measure upon the quickness and scope of perception. Whenever you look at anything carry away some idea of the object looked at. Be no longer idle gazers, but, by constant practice cultivate your eyes so that they will give you a full and accurate idea of what you see. A quickness of perception, joined to a facile pencil, is worth an incalculable amount to an engineer. This faculty, however, is not acquired in a day; it is a steady growth and grows by practice as do our muscles. The son of Houdin, the great magician, had so cultivated this faculty that he could, by a glance at a library as he walked by, carry away the titles of a hundred books in the order of their arrangement on the shelves.

An engineer should add accuracy to integrity and quickness of perception. A quickness of perception without accuracy gives a mere smattering, and a man who lacks accuracy is in a state of chronic apology. Nothing is more baneful than inaccuracy, and this is especially so when it is caused by haste. Do not confound quickness of perception with haste, for haste is always to be avoided. We can cultivate rapidity in our work, if we please, but we must be sure to stop at the point where rapidity by giving up accuracy degenerates into haste.

We must add another quality to the character of our typical engineer, or his quickness of perception and accuracy may result in a knowledge that is superficial merely—a gloss or varnish on the surface of the subject while the interior is unknown. In fine, an engineer must be thorough. This quality must be acquired at the very outset of the career. "As a twig is bent," says the old adage, and as a habit of thoroughness is acquired at the outset, so will be the character.

No adequate knowledge of the rudiments will be obtained without thoroughness, and if the rudiments are faulty, if the foundation is unsound, the subsequent work will be of poor quality. We will find it too late to repeat in after life our study of rudimentary matters, as our time will be demanded elsewhere.

These qualities, just enumerated, will make a successful man for the time being, but they will not keep him successful unless he recognizes the fact that science is in its infancy and grows with each year. The engineer must lay his foundation deep and broad, and must recognize the fact that there is such a thing as "narrowness" to be dreaded.

We hear continually of good engineers who can talk of nothing but their trade; who have no resources outside of their shop; who are unable to appreciate anything that cannot be weighed and sold for profit. In laying the foundation of your character be careful to put in ornamental designs that will add to your worth in your own eyes and in those of the world; and, finally, remember that, as your science is growing and expanding, you must grow and expand also. You cannot stand content, or the great world will sweep by and leave you behind. You must read and work to keep yourselves abreast of the profession you have chosen. You must help form its future, and remember that upon each one of you will rest, sooner or later, a part of the burden. You can not shirk it and be manly; you must undertake with clean hands and a brave heart the task you have chosen for a life work. And, lastly, remember that by your work you will be judged. Let us hope that each will prove a credit and a support to his profession; will prove a typical Engineer.

MINE WATER FORMATIONS.

We often come across some peculiar and interesting things in the coal mines, a great many of them in connection with mine water. It is, no doubt, known to most of those who read this, that mine water contains a very considerable amount of sulphuric acid and ingredients dissolved in it or held in suspension.

In different mines and sometimes in different portions of the same mine, the water presents different aspects. We sometimes find it so free from acid as to be drinkable; again, and not far away, it is such that to touch the tongue to it is sufficient. In

some mines it is the only drink for the mules, while at others the exhaust steam from pumps and engines is condensed, collected, and used for this purpose, the mine water not being fit for use. It is generally so strong in acid that column pipes must be lined with wood in order to render them durable. Were it not for this they would be dissolved or corroded in a short time, and completely ruined. It is common to see rails in the mines eaten almost through by drops of water continually falling from the roof upon the same spot.

I shall now give the results of some observations on various actions and reactions of mine water and mineral matter. My attention was first called to the subject by a white mineral which I found on the bank of a creek. The waters of the creek, the greater part of which came from the mines, had overflowed the low ground on its banks, and on subsidence left this peculiar white coating.

I was told by an amateur mineralogist that this had been examined by an eminent geologist of the American Academy of Sciences and pronounced to be *Alunogen.* On touching it to the tongue the taste of alum was very apparent.

My experiments, as far as I could carry them, corroborated the above opinion. I have since found the mineral in considerable quantities on the walls of the mine near the steam pipes where the heat of the steam evaporated the water, leaving this residue. This contained considerable free $H_2 S O_4$, as I found to my sorrow. I was unfortunate enough to get some on my clothes—there is a place for a patch now.

The accepted theory of the formation of alunogen ($Al_2 S_3 O_{12} +$ 18 aq) is, that the alumina comes from the shale and clay found adjacent to the coal and the SO_3 from decomposition of iron pyrites—what becomes of the iron will be shown presently. Another theory advanced is that the alumina is obtained from the mineral pyrophyllite ($Al_2 Si_3 O_9$), as alunogen had been obtained only on the evaporation of water from mines in which considerable pyrophyllite is found. This, however, will not hold, as I have found this same alunogen in considerable quantity in mines in which pyrophyllite is unknown. I attempted to produce the mineral artificially by evaporating some mine water and succeeded. The color of the natural mineral experimented upon was somewhat yellow, as if from excess of acid and some iron, but after ignition it was red, though not uniformly; the artificial was

white before ignition and remained so afterwards, except a slight redness on the bottom. The artificial retained the shape of the crucible, but the other did not. A considerable amount of fumes was given off by both, and both, on cooling, absorbed moisture and became soft; the artificial slightly, the natural very much so.

This locality (anthracite coal mines) is not mentioned in any books on the subject, that I have seen, but I presume it will be found in later editions.

The mineral, as a cabinet specimen, is very troublesome, as it will attack metal or paper, and can be kept only on glass or porcelain.

The iron from the water affords the most interesting study. We find it frequently as stalactites, suspended from the roof of an old breast or gangway, or as a thick mud covering the bottom of an old gangway to the depth of several feet. The stalactites are sometimes mere pencils three-sixteenths of an inch in diameter, and constructed in the best manner possible for growth. The interior is honey-combed, so that the water has to pass through in a constantly changing course, thus leaving the maximum amount of material behind. Others are somewhat differently constructed, being greater in width and thickness, and the honey-comb structure not so apparent. The most common form, however, is as a yellow mud, deposited in the ditch, or covering the bottom of an old gangway. The amount of this deposit is astonishing, and shows very plainly the formation of iron ore beds.

One instance I note, where in 1000 feet of gangway it has accumulated to a depth of about one foot in six years. By simple calculation for a 10-foot gangway, the amount of deposit is 10,000 cubit feet. It dissolves very readily in cold HCl, and in a mortar no grit is perceptible. I thought likely it would make a good paint, as the color, when burnt, is a very good cherry, but it is probably too heavy to mix with the oil.

Now, where does the iron come from? According to accepted facts and theories, it is leached from the surrounding rock and coal; in my opinion almost entirely from the latter. My reasons for so thinking are these: The adjacent rocks above the coal contain little or no iron; we found the sulphur in the alunogen, which comes from the mine water; why not find the iron, which was combined with the sulphur as FeS_2, with the water also? We certainly have all the conditions for formation of iron ore—decomposing iron pyrites, water charged with CO_2, the presence of

organic matter and the coming in contact with air on reaching the gangway and consequent deposition of $Fe_2O_6H_6$.

If this were to go on indefinitely, perhaps in many years from now the mines would be filled up with iron ore, and those who come after us may reopen the coal mines, but this time for iron ore. We will not let our imagination run away with us, however, as the source of the ore will probably give out before so much has accumulated, even if there were no other difficulties in the way. P.

THE FOUNDATION OF THE WASHINGTON MONUMENT.

When the Government took charge of the construction of the monument its engineer found, on computing the weight of the proposed structure, that the pressure per square foot upon the ground beneath the foundation was greater than the limit of resistance of the soil.

Taking the shaft complete as it now stands, with the original foundation and terrace, the pressure upon the bearing surface would be 8.5 tons per sq. ft., increased, by a wind pressure of 55 lbs. per sq. ft., on the shaft, to 10 tons. These pressures are far greater than such earth as that under the the monument was ever known to sustain. To overcome this difficulty two plans were proposed; the one by confining or hooping in the earth around the foundation so that it could not be displaced; the other by increasing the bearing surface of the foundation. The latter method was adopted. Under the old foundation was placed a mass of Portland cement concrete in the shape of a hollow square whose sides are 126′ 6″, vertical thickness 13′ 6″, and width 41′ 3″. These dimensions bring the concrete mass 18′ under the outer edge of the old foundation and 5′ under the outer face of the shaft at its lowest joint and increases the bearing surface to 16,002 sq. ft.

To join the old foundation to the new and distribute the pressure more uniformly over this mass a large buttress of concrete, extending completely around, was carried from the upper surface of the new foundation to within 3′ of the lower outer edge of the shaft, dove-tailing with the new and the courses of the old foundation.

The execution of this work involved the undermining of a struc-

ture 180′ high, weighing nearly 32,000 tons, and the replacing with masonry of the greater part of the earth upon which it rested. Only a thin vertical layer 4′ in width was tunnelled at a time and every precaution was taken to prevent an unequal strain upon the structure. In filling these trenches the concrete was put in in layers of 6″ and well rammed. When nearly filled, an improvised battering ram was used to drive the concrete snugly into the ends and top of the trench.

During the underpinning not the slightest crack or opening occurred in any joint of the structure, although the several corners settled as follows: S. W. corner 2″.00; S. E. corner 2″.34; N. E., 2″.23; N. W., 1″.90.

The subsidence of the four corners of the shaft during the time occupied in completing the same was as follows:

Year.	Total Additional Weight in Tons.	Total Subsidence of Corners.			
		S. W.	S. E.	N. E.	N. W.
		″	″	″	″
1st	17,000	0.50	0.47	0.52	0.53
2d	22,353	0.79	0.80	0.81	0.85
3d	28,355	1.22	1.25	1.26	1.25
4th	34,604	2.02	2.02	2.03	2.08

The new foundation has a bearing surface of 16,002 sq. ft., giving a maximum pressure per sq. ft., (including that due to the wind pressure on the shaft) of 5.4 tons. The bearing surface of the old foundation had an area of 6,400 sq. ft., and as before stated would have given a maximum pressure per sq. ft., equal to 10 tons.

The depth of the present foundation is 36′ 10″. In the operation of widening that part of the foundation immediately under the shaft 2,098 cubic yards of rubble masonry were removed, and 3,489 cubic yards of concrete built into the new work. Fifty-one per cent. of the contents of the old foundation was removed, and 48 per cent. of the area of the shaft undermined.

[Condensed from report as read before the Society by Mr. Millholland.]

THE VELOCITY AND DISCHARGE OF THE LEHIGH RIVER ABOVE BETHLEHEM.

Following the instructions of Prof. Merriman, the Civil Engineers of '86 made the necessary measurements during the Fall of 1885, for the purpose of ascertaining the mean velocity and dis-

charge of the Lehigh River. That part of the river west of Calypso Island was chosen because the banks for nearly 2,000 feet are approximately parallel, the bed is tolerably uniform, and no artificial causes exist to disturb the flow of the water. These conditions are necessary to obtain good average results. The methods pursued, were, in brief, as follows:

Three parallel sections, 100 feet apart, were located by means of the sextant. They were taken perpendicular to the course of the current and were divided into 10 parts of 30 feet each. Soundings were taken at each of these points with a pole divided into feet and tenths.

The sections were thus divided into trapezoids, and, having now the necessary data, the area of each section was computed.

The next step was to find the velocity for each compartment into which the river had been divided. To obtain this, floats were employed. As the velocity of a stream decreases from the surface to the bed, it becomes necessary to obtain the mean velocity. This was found in the present case, by using floats which just cleared the bed of the river. The 10 floats required were made of rectangular pieces of wood, weighted so as to have them float vertically. They were made of the necessary lengths, taken from the previous soundings. The floats were placed in the water at some distance above the first section, so that they would acquire the full velocity of the river before they reached that section. An assistant on the shore noted the time as each float passed the three sections. Knowing thus the time it took for each float to pass between the two pairs of sections, and the distance between being 100 feet, we were able to compute the mean velocity for each compartment of the river by simply dividing the distance by the time. As the discharge in a unit of time equals the area multipled by the velocity, therefore taking the mean area for each compartment and multiplying it by the mean velocity of that part of the river corresponding to the area in question, gave us the discharge. Then, taking the sum of these discharges as computed for the ten parts, we obtained the mean discharge of the river. Finally, the mean velocity was found by dividing the mean discharge by the mean area of the cross section.

The class had been divided into two parties. The first of these made their observations Oct. 15th, when the height of the water at the upper section was 3.86 feet above the zero point of the gauge at the north end of the old Lehigh Bridge. They obtained

the following soundings for the upper section, commencing with with the south bank:

DISTANCES.	SOUNDINGS.
At 30 feet	3.0 feet.
60 "	6.0 "
90 "	7.1 "
120 "	7.0 "
150 "	7.0 "
180 "	5.3 "
210 "	4.3 "
240 "	3.0 "
270 "	2.2 "
300 "	0.6 "
302 "	0.0 "

The whole area was found to be 1,413 sq. ft. Similar soundings for the other sections gave the areas 1,407 and 1,405 sq. ft.

The times required to float between the upper and middle sections, and the velocities for each compartment deduced from these times are given in the following table, commencing at the south shore:

TIME REQUIRED.	VELOCITY IN FT. PER SEC.
6 min. 20 sec.	0.263
3 " 40 "	0.454
3 " 5 "	0.540
2 " 00 "	0.833
2 " 25 "	0.690
2 " 30 "	0.667
2 " 45 "	0.606
3 " 20 "	0.500
5 " 20 "	0.313
7 " 10 "	0.233

The velocity of the river for each compartment of the middle and lower sections was obtained in a like manner.

The mean area of each compartment for the upper and lower sections was then multiplied by its corresponding velocity as found above, and the following results were obtained:

MEAN AREA IN SQUARE FEET.	DISCHARGE IN CUBIC FEET PER SEC.
55.5	14.6
148.5	67.5
201.75	109.0
217.5	181.2
210.0	144.9
186.0	124.1
150.75	91.4
114.0	57.0
84.0	26.3
42.0	9.8

The total discharge for these sections amounted to 825.8 cu. ft. per sec. The discharge, corresponding to the middle and lower sections, was found to be 768.8 cu. ft. The mean of these results gives us 797 cu. ft, per sec., or 47,832 cu. ft. per min.

The mean of the areas of the three sections is found to be 1409.3 sq. ft. Therefore the mean velocity equals $\frac{797}{1409.3}=0.565$ feet per second.

The second party made their observations Oct. 22, when the surface of the water at the first section was 4.45 feet above the zero point of the gauge.

The mean discharge as found by them was 1336 cubic feet per second. The mean of the areas was 1630, therefore the mean velocity in feet per second was 0.82.

JNO. H. SPENGLER.

An interesting editorial in the *Engineering and Mining Journal* of Feb. 20, on the Natural Gas of Pittsburgh and vicinity, is worthy of particular attention. The following summary by Prof. Lesley, is quoted:

"1. As gas is a direct product of petroleum by spontaneous evaporation, the life of the gas production will be limited by the amount of the volatile elements held in a definitely limited quantity of petroleum existing under ground; and therefore, those who are producing and using this enormously valuable mineral substance should take every precaution to prevent its waste, seeing that it is bound to come to an end.

"2. I have for a long time looked upon the extension of the Butler oil-belt in a general southwest direction through Washington and Greene counties and into Virginia as probable, and I believe now more confidently than ever, since the drilling of the Washington district wells, that a considerable addition to our oil and gas wealth will be made in future years by a long series of oil and gas strikes at greater depths in that direction."

The subject of water-gas as an economical fuel, is briefly referred to in the same connection, and the opinion is expressed that the use of natural gas in Western Pennsylvania will hasten the day when the anthracite of the east will be converted into water-gas at the mine, and be furnished to the various manufactories by means of an immense system of distributing mains.

—On January 5 there was a freshet in the Lehigh River, which inundated Sand Island and a portion of Old South Bethlehem. The water reached the height of 12½ feet above low water mark, which is greater than that of any freshet since 1869, when 19½ feet was indicated. The freshet of 1862 reached 21 feet, and the great flood of 1841 is said to have been higher yet.

ALUMNI NOTES.

1869.

—J. H. H. Corbin, A. C., has recently been East for a short time.

—Miles Rock, formerly of Bethlehem, a graduate of the Lehigh University, who for several years past has been engaged in surveying the boundary line between Guatemala and Mexico, lectured before the Anthropological Society of Washington, D. C., on some of the ancient ruins, before unknown, which he visited during the course of his surveying operations. These venerable ruins are in a vast basin of the Lagartero River, a tributary of the Chiapas. The country gives evidence of having once been thickly populated, as the remains of towns and cities lie scattered over the entire area of the basin. A remarkable fact is the indisputable evidences of the great denudation of the apparently once deep, rich soil formerly tilled, leaving the surface in many places barren rock. The denudation must have been going on long before the abandonment of these villages and cities, as is evidenced on all sides by the efforts made to check it by artificial means. Walls and terraces exist everywhere, which in some instances have been successful in retaining small patches of tillable soil. The ruins themselves consist largely of stone floors raised above the ground, and which were seemingly the basis of superstructures built of less permanent and more perishable materials. All these remains show unmistakable evidences of great age, and Mr. Rock is of the opinion they are more ancient than the remains found in Yucatan and Central America. The work of the survey is not yet completed, the recent revolutionary operations in Guatemala having interfered with the work. There is no doubt that the entire country from the southern boundary of California down to Panama still remains a rich field for archæologists.

1879.

—J. S. Cunningham is staying at Allentown now, being no longer with the Everett Iron Co.

1882.

—L. O. Emmerich is now with J. C. Hayden & Co., coal operators, Jeansville, Pa.

—E. H. Lawall is Engineer at the Stockton, Beaver Brook, Silver Brook and Black Ridge Collieries.

1884.

—R. W. Walker now writes himself: Senor Don Ricardo W. Walker, care del. Jefe de la Comision de Limites de Guatemala, C. A.

1885.

—D. K. Nicholson is with the Midvale Steel Company, Nicetown. His address is 600 Buttonwood street, Philadelphia.

—H. L. Bowman, now at Millersville, Pa., expects to be back in Bethlehem, in the employ of the Bethlehem Iron Co., shortly.